EcoOnline™

12V/24V Solar Regulator

For the EcoOnline Solar Kits using the

1R/20Amp/24V

Solar Charge Controller

Installation Manual & User Manual - Revised 31/01/2015

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1 Key Terms

Congratulations on the purchase of your EcoOnline™ Solar Regulator Kit. Please print this manual out for your reference. Please take the time to read the manual before starting any work. Particular attention should be given to text contained in the following key terms.

Please note EcoOnline has a strong product safety policy; do not install products without reading safety guidelines in the manual. Please report any product safety issues or near misses to info@EcoOnline.com.au no matter how trivial.

DANGER	Indicates a **SAFETY** issue that **is likely to** cause injury or death if the user does not follow the instructions.
WARNING	Indicates a **SAFETY** issue that **may** cause injury or death if the user does not follow the instructions.
CAUTION	Indicates a **SAFETY** issue that **may** cause injury or property damage if the user does not follow the instructions
Read Carefully	Refers to **critically important** information related to the **correct functioning** of the system.
Tip	Refers to useful information for the **optimal operation** of the system

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2 Safety Requirements

DANGER	**Lead acid batteries generate dangerous explosive gases** during normal operation; always provide adequate ventilation to the outdoors. Wear eye protection and gloves at all times when working around lead acid batteries. Be mindful of sources of ignition such as sparks from shorts, fuses, open flames or cigarettes. Note: batteries store a large amount of energy. Never short circuit a battery's positive (+) and negative (-) terminal. Have fresh water available to wash and clean any contact with battery acid.
DANGER	**When sizing your solar array and battery you must check that the maximum current produced by the chosen solar panel(s) array can never exceed the maximum allowable charging current for the battery being charged.** Always follow the battery manufacturer's charging instructions. Please note: panels can produce up to 30% more power than the panels rated power under extraordinary solar conditions.
WARNING	EcoOnline recommend de-rating the regulator. Solar panel wattages and connected loads should **not exceed: 240W solar power (at STC for a 12V system)** or **15Amp continuous load** for the **20Amp regulator.** If appliances are connected to the battery through the regulator, then the **total surge start up current** from all connected appliances should not exceed the 20Amp rated current for the regulator.
WARNING	This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.
WARNING	This regulator is to be used for charging Sealed (AGM), Gel or Flooded **Lead-Acid** type batteries **only**. Not to be used for charging any other battery chemistries apart from **Lead-Acid**. You should check that the **maximum voltage** of the charging profile you select does not exceed the battery manufacturers recommended maximum charging voltage.
WARNING	Always use appropriate gauge wires. Never exceed the rated **Ampacity** (amp rating) of a wire. Keep in mind that **wires situated in highly insulated environments cannot dissipate heat** and hence will have a much lower Ampacity. This could lead to a fire hazard.
WARNING	If you are unskilled in making safe electrical connections, we recommend all electrical connections be carried out by a certified electrician. **Loose, corroded or fatigued electrical connections can become resistive and overheat creating a fire hazard.**
WARNING	An appropriate fuse must be installed on the positive **regulator to battery** connection. Some batteries and/or **banks of batteries connected in parallel** are capable of very high short circuit currents and **may also require a current-limiting fuse**. You should check with your battery supplier as to the type of recommend fuse.

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WARNING	Do not expose this regulator or system components including solder joins to water and/or high humidity and/or corrosive environments such as those involving marine applications.
WARNING	**Always disconnect all connections to the regulator before attempting any maintenance** or cleaning to reduce risk of electric shock. Note: there are no serviceable parts inside the controller; do not attempt to repair the controller. Incorrect re-assembly can cause fire.
WARNING	Only use 12V "nominal" (36 cell) solar panels with this regulator. Or 72 cell panel(s) for a 24V system.
WARNING	What follows are general installation guidelines, **they should NOT be taken to be appropriate for all installation situations**, if in doubt please seek advice from a certified electrician.

3 Warranties

EcoOnline™ offers the following Warranties

- 3 year limited Warranty on all Regulators

See EcoOnline.com.au Terms and Conditions page for further details.

4 Included Kit Components (depending on the kit purchased)

20Amp Solar Charging Regulator	two core 1.0mm^2-1.5mm^2 5m Solar Wire (10Amp)	single core 2.5 -4mm^2 Battery Wire	20Amp Fuse holder, 30Amp fuse kit.

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5 Designing Your Charging System

Firstly, please visit our online sizing calculators to size your system. They will help you understand important factors involved in sizing a solar charging regulator system. **(Do not assume the supplied components are suitable for all situations!)**

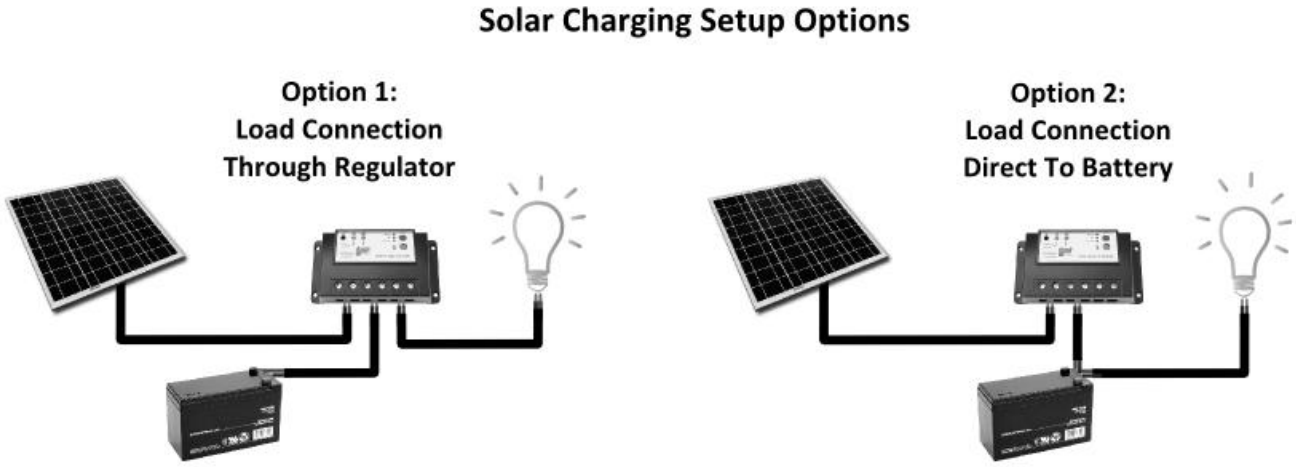
1. Solar Panel Sizing Calculator (this will help you understand the factors involved in a **sizing solar panels**)
2. Solar Regulator Calculator (this will help you understand the factors involved **sizing a regulator**)
3. Solar Wire Sizing Calculator (this will help you understand the factors involved in **sizing wire gauges**)

WARNING

A charging system must be sized right, for efficiency, reliability and **safety**. If in doubt please seek advice.

6 Connecting the Load Direct to Battery or Through the Regulator

The first choice you have to make is whether you will be connecting your 12V/24V load direct to the battery or through your regulator.



Option 1: (Recommended) Advantages	Option 2: Advantages
* Regulator will protect the battery from low voltage deep discharge	* Regulator and **regulator to battery** wire need only be sized to the maximum power of the solar panels
Option 1: Disadvantages	**Option 2: Disadvantages**
* Expensive high gauge wire will be needed if you have a high power load and a long **battery to regulator** distance * You'll need to size your regulator to handle the load	* No deep cycle protection for the battery

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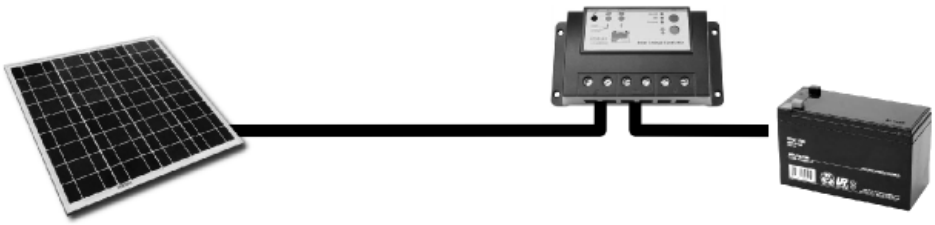
7 Recommend Position of Regulator

We recommend the regulator be positioned near the battery.



WARNING	The regulator **should not** be mounted in the same compartment as flammable objects or items that can leak flammable gas or vapour, such as lead-acid batteries, solvent, gas or oil sources. **If installing in the same compartment as lead acid batteries there should be sufficient ventilation.**
WARNING	Do not allow the regulator to be exposed to rain or moisture.
Tip	Please note: when choosing a location for the regulator it is preferable that the regulator and battery compartments have similar ambient temperature characteristics so that the temperature compensation function on the regulator functions accurately.

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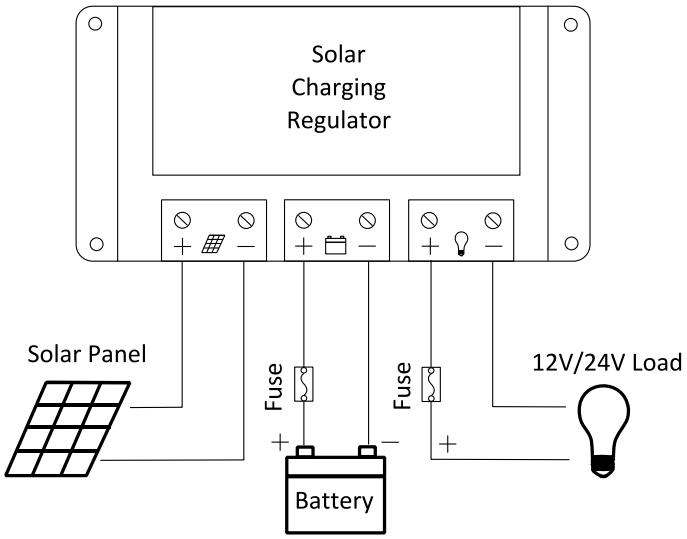
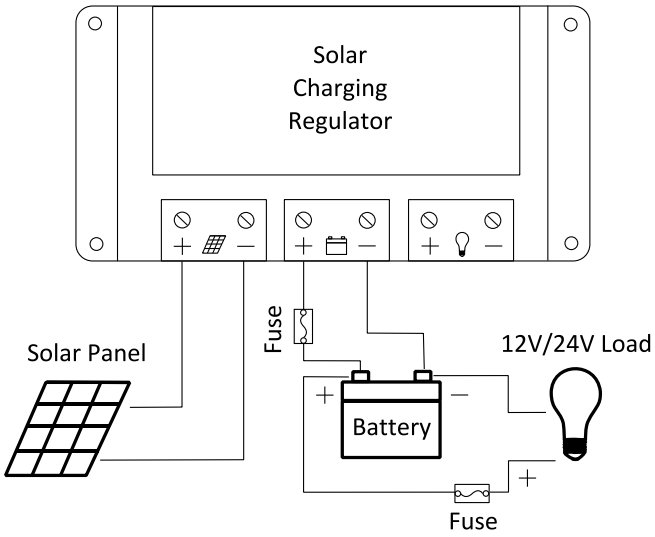
8 Fuse and Technical Wiring Diagrams

Wiring Diagram for:
Load Through Regulator System



Wiring Diagram for:
Load Direct from Battery System



WARNING	The **1R/20Amp/24V** regulator should have **a 30Amp fuse**. You should check with your battery supplier as to the type of fuse to use as some batteries and/or **banks of batteries connected in parallel** are capable of very high short circuit currents and may require a special **current-limiting fuse**.
WARNING	Note: the fuse assembly should be close to the battery but no closer than 150mm from the battery terminals.
WARNING	Always use appropriate gauge wires. Never exceed the rated **Ampacity** (amp rating) of a wire. Keep in mind that **wires situated in highly insulated environments cannot dissipate heat** and hence will have a much lower Ampacity. This could lead to a fire hazard.

9 Fuse Assembly

Step 1: Choose a conveniently accessible, rain sheltered location for the fuse assembly.

WARNING	Note: the fuse assembly should be close to the battery but no closer than 150mm from the battery terminals.

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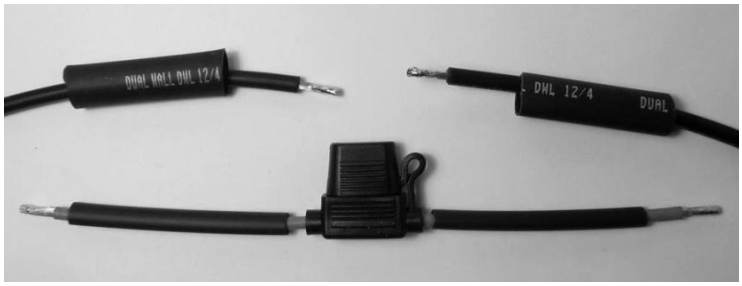
WARNING

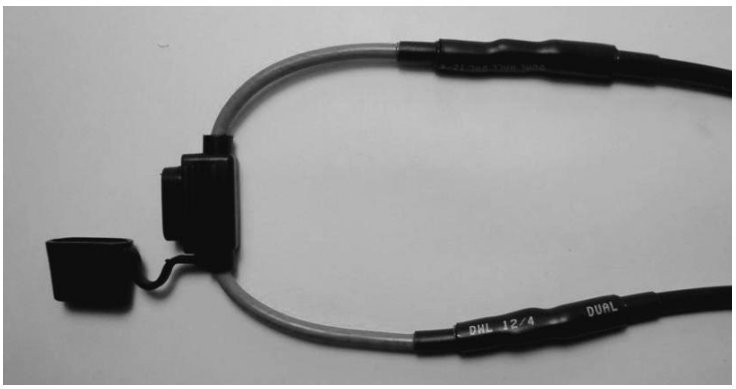
For the battery to regulator wire, if you are also connecting the load through the regulator you need to consider max load current not just the max charging current. You may need a substantially higher gauge wire.



Step 2: Measure and cut the **battery to regulator** cables. For the +ve positive line cut the wire at the chosen fuse holder location. Strip and tin solder all wires appropriately in preparation for a lap splice, follow Section 17 below.

NOTE: Before you solder **don't forget to thread all FOUR heat shrink tubes**.
Step 3: Solder the fuse holder in-line at both ends using a lap splice. Tape down ends to hold in place during soldering. **Clean flux residue from the solder using suitable solvent.**

Step 4: Use a heat gun to the heat shrink the first sleave. You'll need a glove to protect your fingers when you press the hot heat shrink firmly around the wire so that the hot adhesive creates a good seal.



Step 5: Use a heat gun to the heat shrink the second sleave. The fuse assembly is complete and ready for mounting.

WARNING

Note: Fuse assembly is only dust proof and should not be exposed to the sun and moisture. Fuse assembly and wire should be fixed in place to prevent wire movement and fatigue. There should be no flammable objects in contact with or above and below the fuse assembly. **If the solder or fuse connections become corroded, or fatigued over time, resistive heating in these connections can result in a fire.** Depending on the installation the entire fuse assembly should be placed in an electrical junction box.

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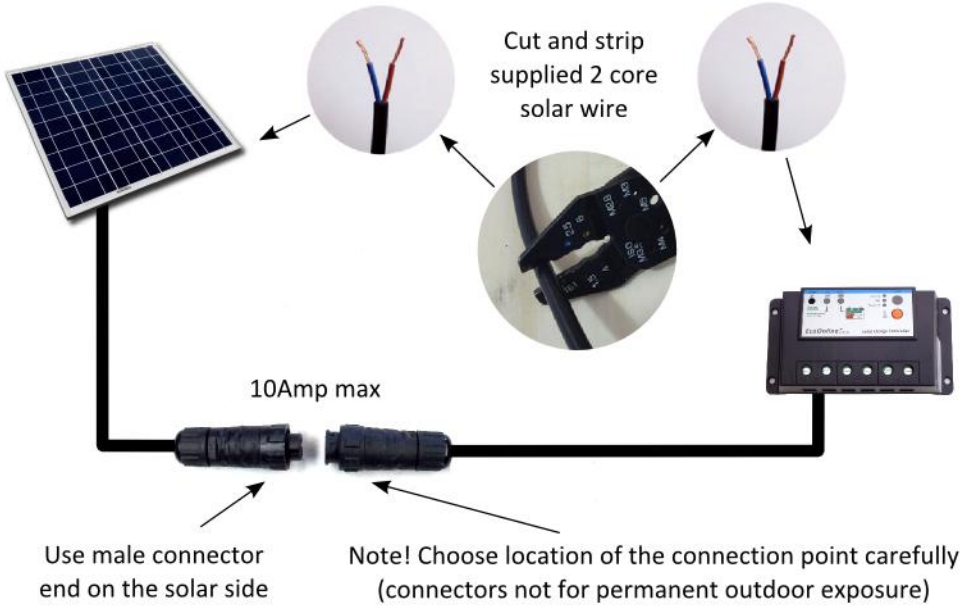
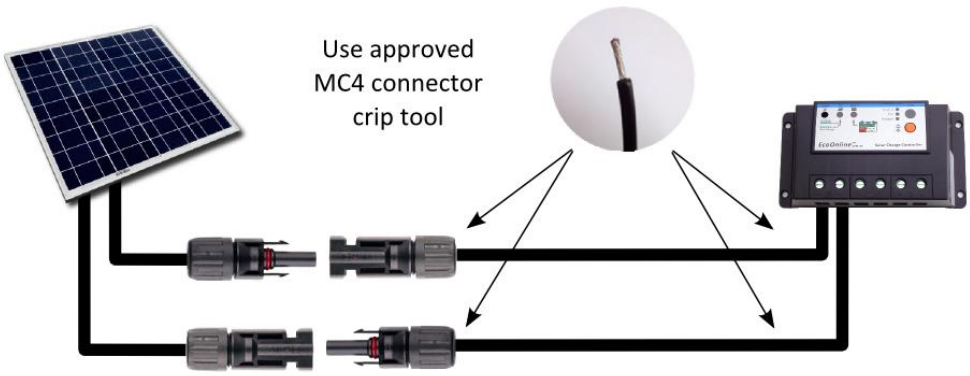
10 Solar Panel Wiring

10.1 Solar Connection Using Twin Core Wire and Connector – for 12V system


Cut and strip
supplied 2 core
solar wire
10Amp max
Use male connector
end on the solar side
Note! Choose location of the connection point carefully
(connectors not for permanent outdoor exposure)

10.2 Solar Connection Using Single Core Wire and MC4 Connectors – for 12V system



WARNING

NEVER screw clamp solder tinned wires to the solar junction box terminals. Wires must be soldered onto the terminals inside the junction box.

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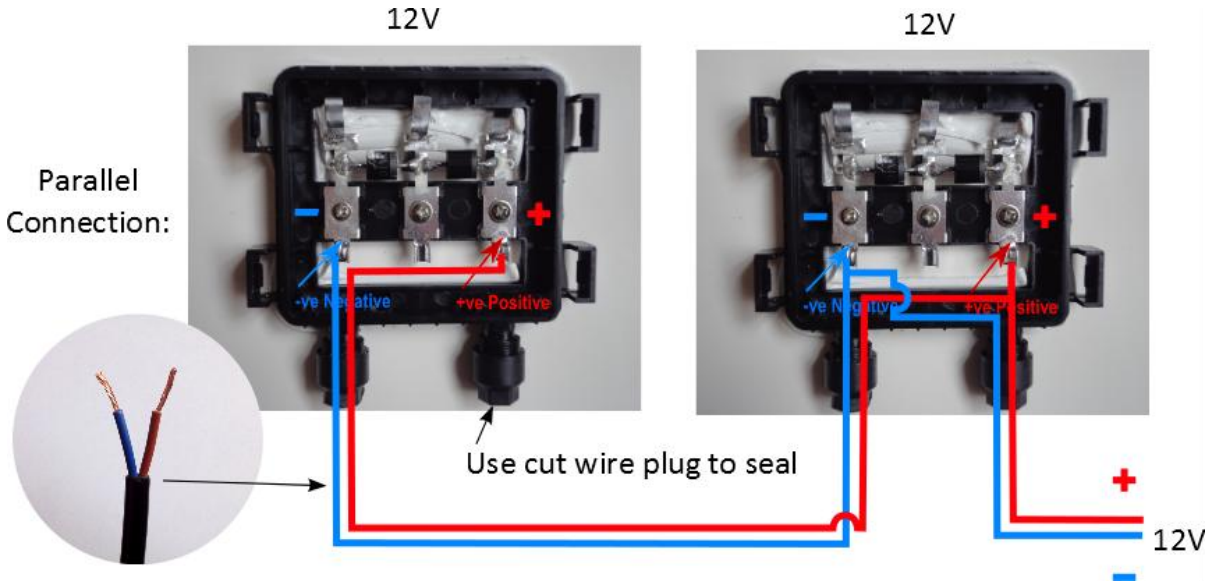
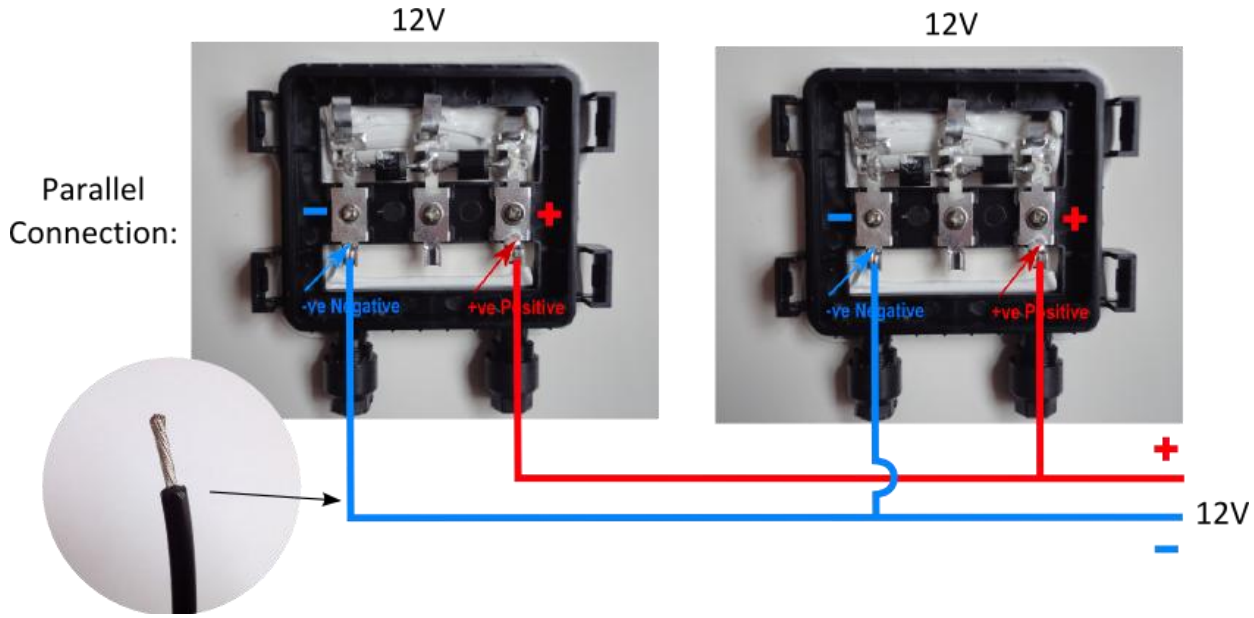
CAUTION

Always check that the solar modules are wired for the same voltage as the battery by using a **multimeter**. Open circuit voltage of a "12V nominal" or 36 cell solar panel or in parallel connected solar panels should be around 21V. This should be doubled for a 24V system.

10.3 In Parallel Connection Using Twin Core Wire – for 12V system



10.4 In Parallel Connection Using Single Core Wire – for 12V system



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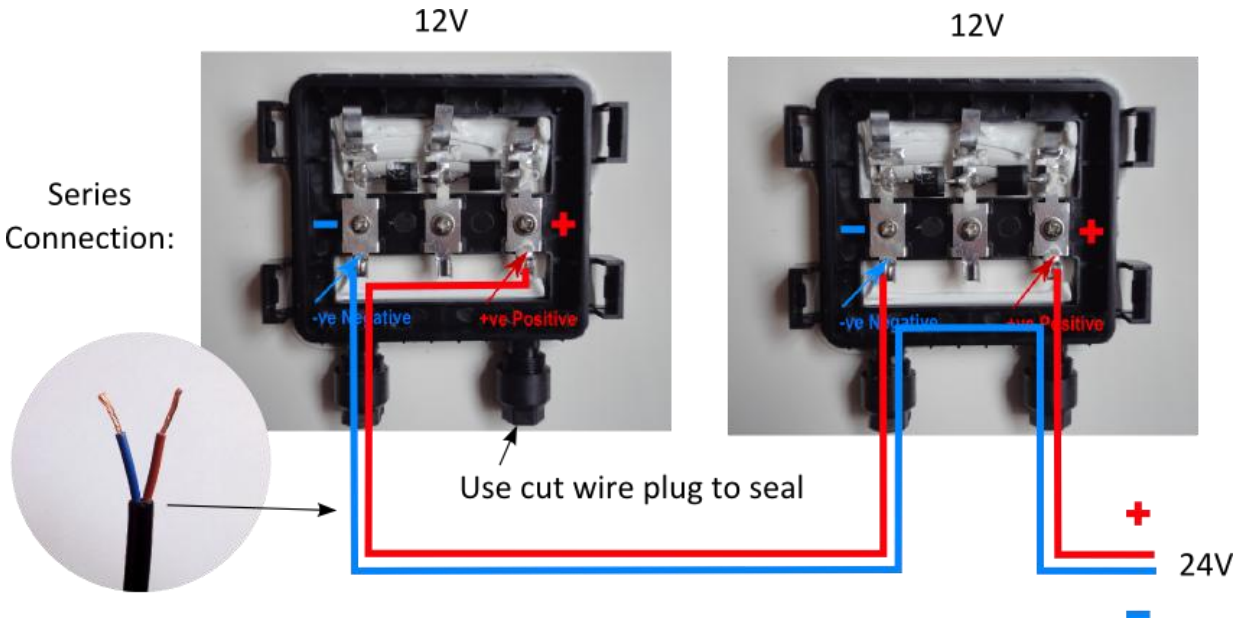
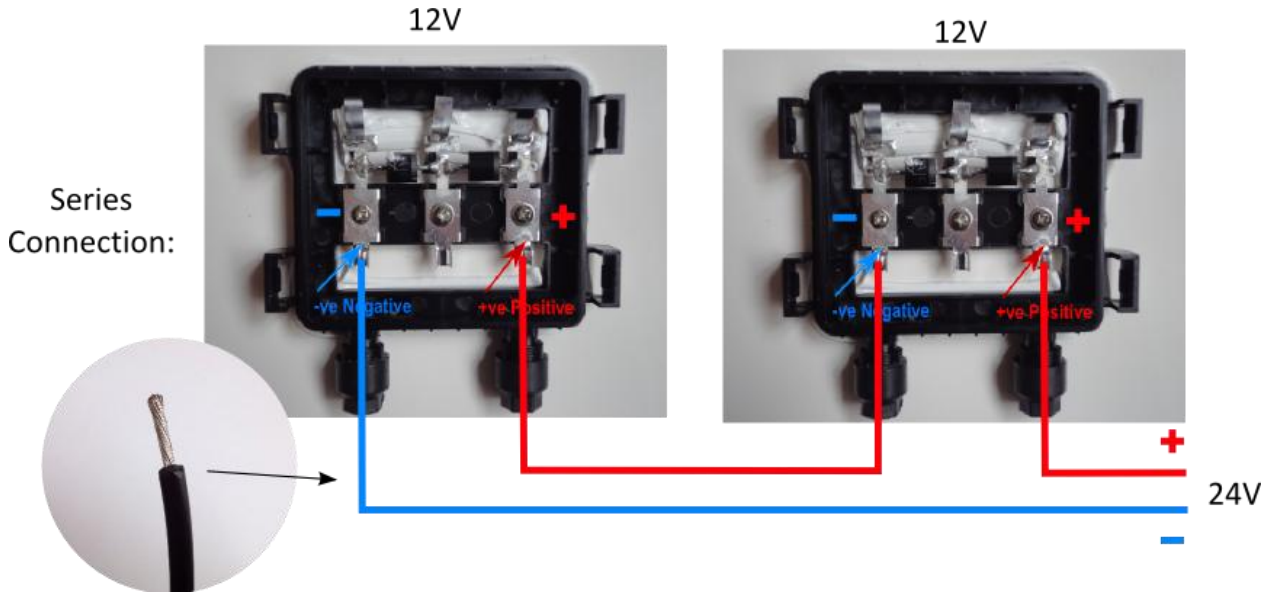
10.5 In Series Connection Using Twin Core Wire – for 24V system



10.6 In Series Connection Using Single Core Wire – for 24V system



CAUTION	For a 24V system the battery voltage must be greater than 18V for the controller to recognize and set the system as a 24V system.
Read Carefully	**Panels wired in series must be of equal power and face exactly the same direction.** Panels wired in parallel can face different directions.

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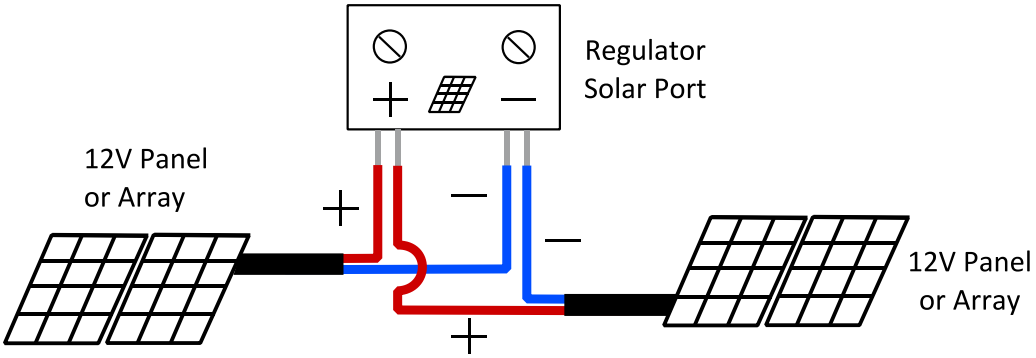
11 Wiring in Twin Folding Panels

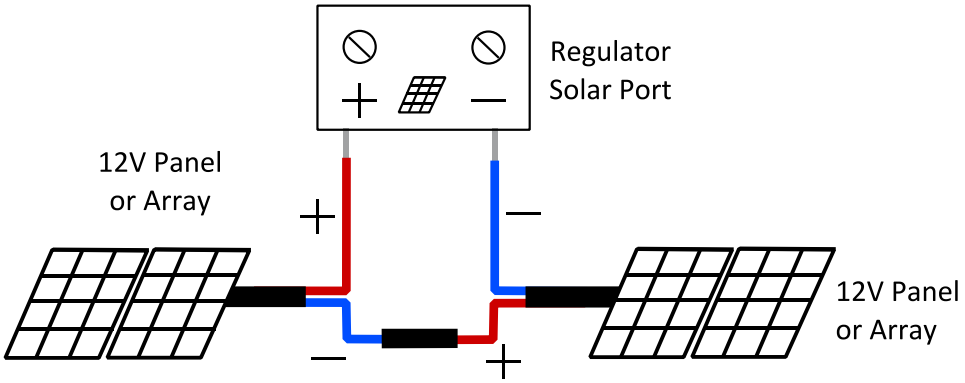
12V System

Connect Panels in Parallel



24V System

Connect Panels in Series



CAUTION

Always check that the entire solar array is wired for the same voltage as the battery by using a **multimeter**. Open circuit voltage of a "12V nominal" or 36 cell solar panel or in parallel connected solar panels should be around 21V. This should be doubled for a 24V system.

Read Carefully

Panels wired in series must be of equal power and face exactly the same direction. Panels wired in parallel can face different directions.

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12 Mounting the Solar Panel(s)

12.1 Mounting on Building Roof or Caravan

WARNING

If the panels are to be mounted on a building roof **always check council/building regulations in your area**. We recommend roof mounting of panels be performed by a qualified professional that can advise on appropriate mounting means for your situation.

Generally, when mounting panel we also recommend:

- Panel(s) should be mounted **as close to the ground as possible** for **ease of maintenance**, **reduced wind loading**, **shorter wire runs** and a **reduced chance of lighting strike**
- Electrical connections in junction box **MUST be soldered on**.
- The **underside moisture barrier should not be scratched** as this the will severely limit panel lifetime.
- **Do not use self taping screws** into the side of frame when installing panels; use the bolt holes on the back with locking bolt & nut set or commercially available mounting means.
- Panels should be installed with 20mm to 50mm underside ventilation gap.

12.2 Portable/Folding Solar Camping Panel(s)

WARNING

We recommend portable/folding panels are placed on a secure, flat, **non-flammable surface** exposed to the sun. As a precaution **do not place panels on or in dry flammable grass for example**.

WARNING

For portable/folding panels with a regulator on the back we also recommend you discontinue use if the outside temperature is greater than 40DegC. Note: the regulator and fuse holder must have air flow during use; do not cover system components.

Read Carefully

We recommend the portable/folding panels be put away in very strong wind, or if there is a chance of lighting. In moderate winds a heavy object can be place on the frame legs to secure again overturning.

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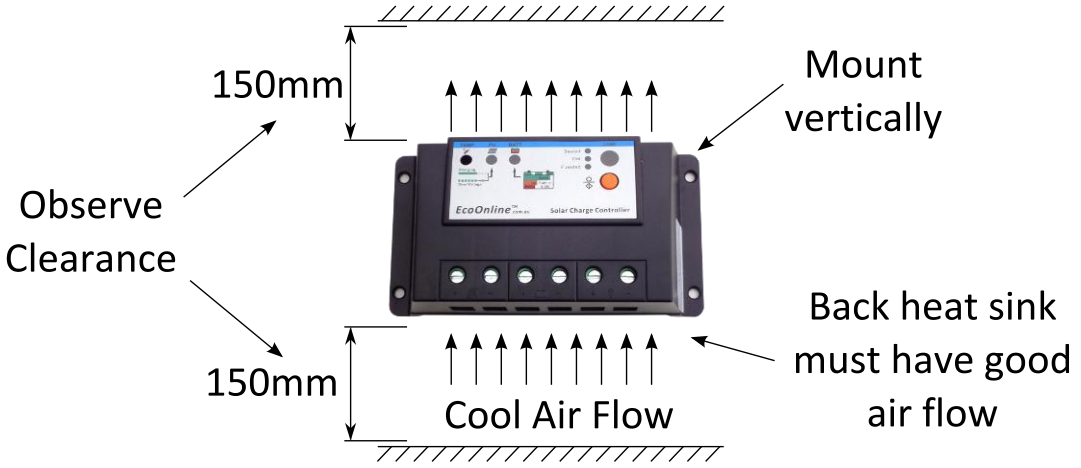
13 Mounting the Charging Regulator



WARNING

The controller must be mounted on a **vertical**, **non-flammable surface,** in a cool, dry, sheltered location with adequate ventilation**. Note: the heat sink will get hot under operation.** Ensure that there is sufficient air flow around the back of the controller.

14 Regulator Connections

WARNING

When inserting wire into the **20Amp regulator use exactly 13mm bare wire**.

DO NOT solder these wire tips before connecting to the regulator. Soft solder can corrode, arch, melt and/or soften resulting in the cables falling out.

WARNING

Unscrew the regulators connection ports **fully** before inserting wire. Make sure the wire is inserted between the regulators gripping teeth and that the connections are tight. Loose connections can generate heat due to excessive resistance. Make sure there are no protruding wire strands. **You should do a pull test to make sure wires can't be pulled out.**

WARNING

For mobile applications, always secure all wiring to a solid surface. Unsecured wires and connections, that vibrate or work themselves lose will become resistive which could lead to excessive heating and/or fire.

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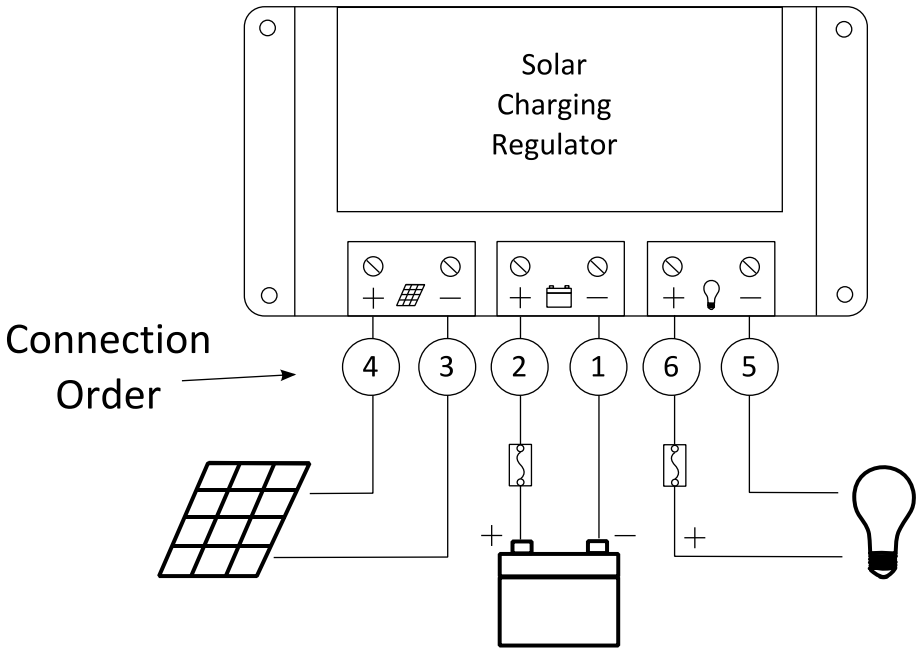
15 Wiring and Connection Order



WARNING	Always power the regulator ON by connecting the battery first before making other connections. The regulators light(s) should come on. This will activate the units numerous protection mechanisms.
WARNING	When wiring your system never run a 12-24V cable near or in the same compartment or conduit as other 240V cables due to the chance of mistaking the two cables at some later point in time during installation or servicing.
WARNING	Depending on the installation we recommend wiring be performed by an experienced and/or qualified person such as an electrician.

16 Auto Voltage Selection - 12V or 24V System

WARNING	Note: the controller will sense and set the system voltage from the battery voltage. If the battery voltage is lower than 18V, it will recognize the system as 12V. If the battery voltage is greater than 18V, it will recognize the system as 24V.

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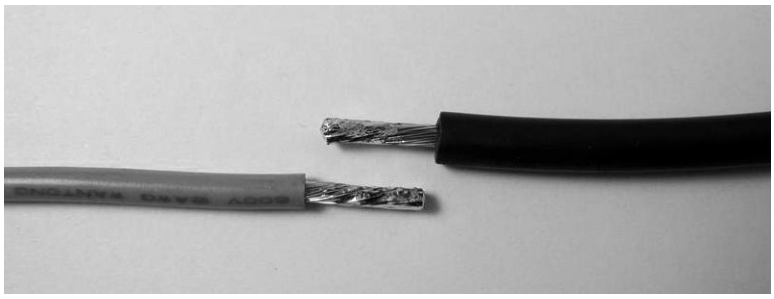
17 Lap Splice Soldered Connection

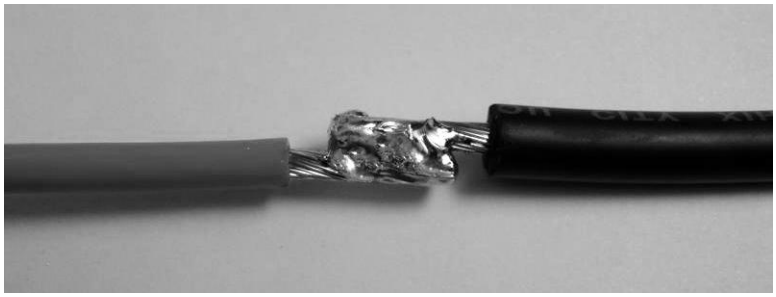
WARNING

A soldered lap splice can be used with this kit to make connection but **ONLY for applications where the wiring and splice joins are to be fixed in place WITHOUT potential for tension or repetitive bending movement across splice joins.** Use ONLY rosin-core solder that is specifically approved for electrical work.



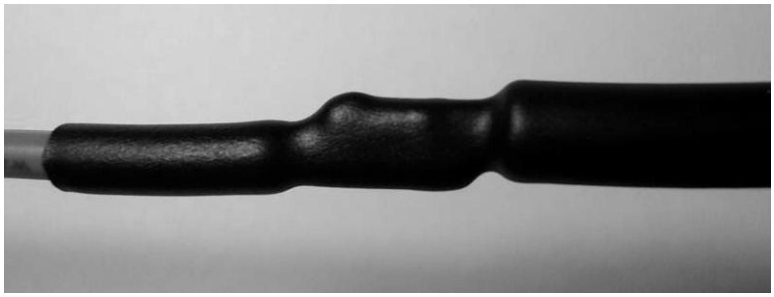
Overlap area should be **at least 3 wire diameters but no more than 5 diameters**. Wire overlap must be well pre-tinned with solder.

* DO NOT nick wire while stripping insulation
* DO NOT allow solder to diffuse into the length of the wire more than 5 wire diameters from tip.



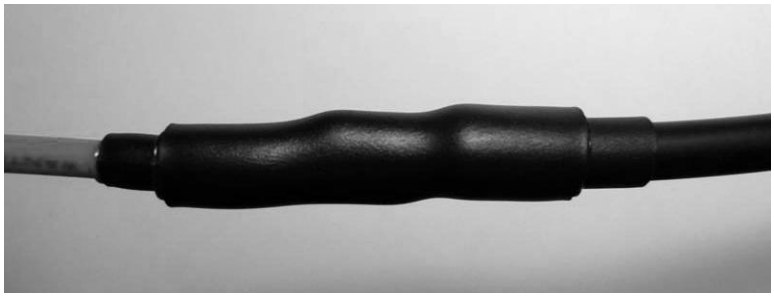
Solder the overlapping wire ends **together across the entire overlap** using sufficient heat to fully melt the solder. Tape down ends to hold in place during soldering. Clean flux residue from the solder using suitable solvent. Cut off any protruding wire strands.

* DO NOT allow movement during the solder solidification process



Use a heat gun to heat adhesive lined heat shrink sleave. Press ends to seal.

* DO NOT use a naked flame or soldering iron to shrink heat shrink sleave



Apply secondary heat shrink sleave to immobilize the splice to protect against metal fatigue of solder. Press ends to seal.

* DO NOT expose the stiff splice to tension or metal fatiguing bending forces. When mounting soldered splice should be fixed in place at both ends.

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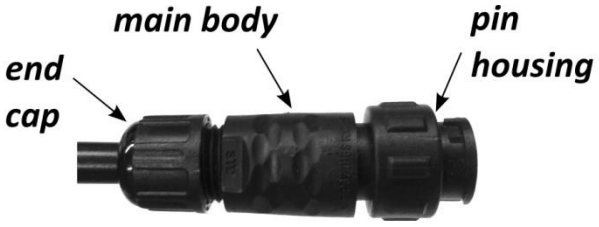
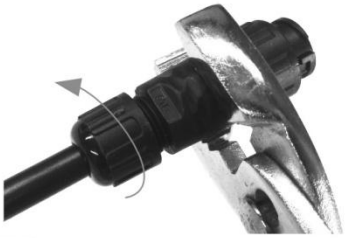
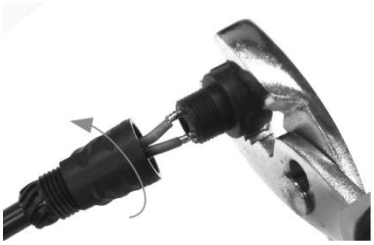
18 Connector Dismantling Procedure (if required)

Definitions





Step 1: Hold connector by ***main body*** unscrew ***end caps*** for both connectors (use second pliers if required)



Step 2: With ***end cap*** removed, hold female connector by ***pin housing***, unscrew ***main body*** (use second pliers if required)

Step 3: With ***end cap*** removed, hold male connector by ***pin housing*** using a spanner, unscrew ***main body*** (use second pliers if required)

Read Carefully

Note: you may need to compress the ***main body*** of the connector to break the glue seal. This should be performed by gently compressing the ***main body*** until you hear the seal break.

WARNING

Note the 10Amp limit for these connectors. We recommend connectors are not mounted such that they are continuously exposed to rain and water ingress.

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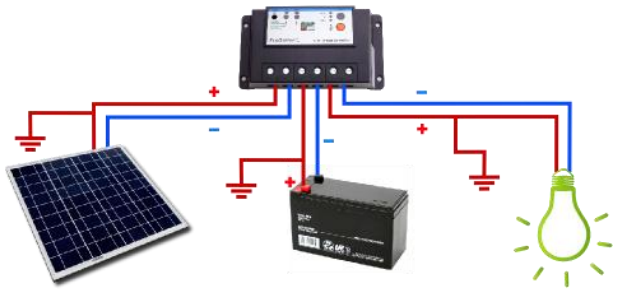
19 System Grounding

Grounding the regulator is not technically required for simple camping type stand-alone solar systems.

CAUTION	If for some reason grounding is required it should be noted that this is a **positively ground regulator**. (See below for allowed grounding configurations.)

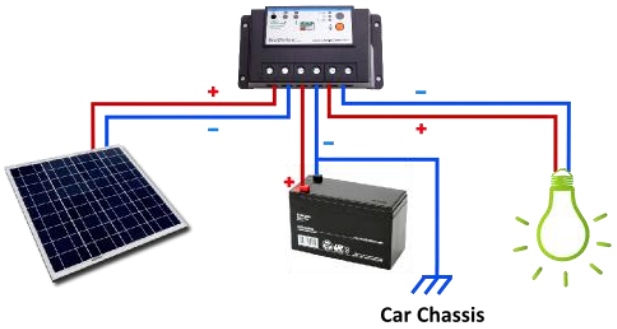
Grounding Option 1

✓ **OK**



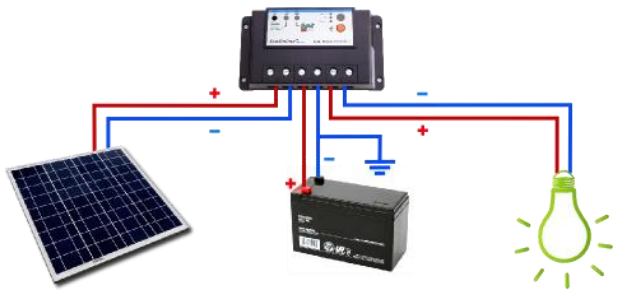
Grounding Option 2

✓ **Caution**



Grounding Option 3

✓ **Caution**



CAUTION	Grounding option 2 and 3 should be used with **caution** as for these configurations the controllers positive wires cannot be allowed make electrical contact to the ground or the car frame.
WARNING	When using Option 3, never mount the regulator near grounded chassis parts and always secure the wires going into the regulator as they could become loose and potentially fall out touching chassis parts.

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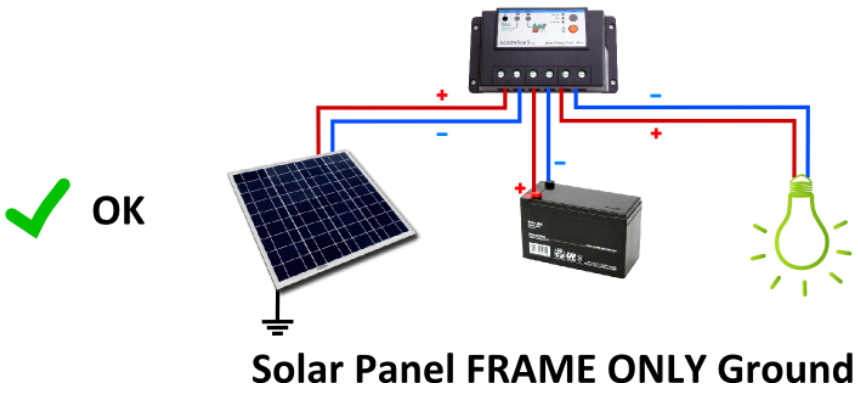
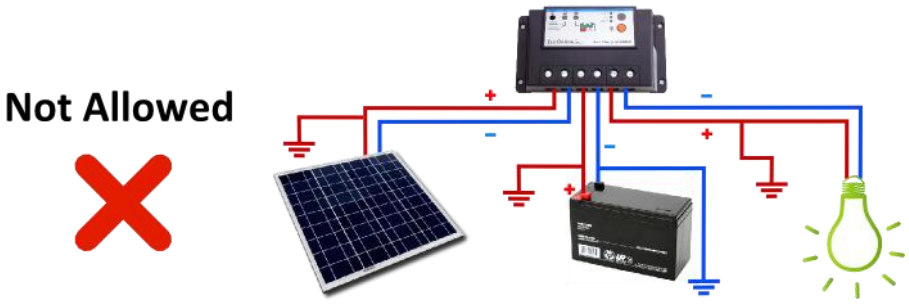
19.1 Frame Grounding Option



19.2 Forbidden Grounding Options



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20 Specifications

20.1 General Regulator Specifications

General Specifications		
Description	**Parameter**	
Nominal System Voltage	12VDC	24VDC
Battery Voltage Range	9V-16V	18V-32V
Recommended Solar Panel	36 cell	72 cell
Maximum Short Term Current	20A	
Maximum Continuous Current	15A	
Charge Circuit Voltage Drop	≤0.26V	
Discharge Circuit Voltage Drop	≤0.15V	
Self-consumption	≤6mA	
Temperature Compensation Coefficient*	-30mV/˚C/12V (at 25˚C)	
Terminal size	6mm	
Operating temperature	-10˚Cto +45˚C	
Storage temperature	-35˚C to +70˚C	
Humidity	Max. 90%	
Enclosure	IP30	
Regulator Physical Dimensions	length 144mm x width 75.8mm x height 45mm	

* Compensates equalize, boost, float and low voltage disconnect voltages.

Lead Acid Battery Types			
Regulator selection	**GEL**	**SEALED**	**FLOODED**
Common names	“VRSLAB” also "Sealed" or "Maintenance free"		Lead Acid Battery*
Technical name	Gelled Electrolyte	Advanced Glass Mat (AGM)	Wet Cell Lead Acid
Electrolyte type	Gel suspension	Glass mat suspended liquid	Liquid

* Note some wet cell batteries have sealed tops and are marketed as "maintenance free" however these are still classed as FLOODED type batteries.

Battery Voltage Charging Parameters (at 25˚C)			
Charging Parameter	**GEL 12V(24V)**	**SEALED 12V(24V)**	**FLOODED 12V(24V)**
Equalize Charging Voltage	-------	14.6V (29.2V)	14.8V (29.6V)
Boost Charging Voltage	14.2V (28.4V)	14.4V (28.8V)	14.6V (29.2V)
Float Charging Voltage	13.8V (27.6V)	13.8V (27.6V)	13.8V (27.6V)
Boost Reconnect Charging Voltage	13.2V (26.4V)	13.2V (26.4V)	13.2V (26.4V)
Low Voltage Reconnect Voltage	12.6V (25.2V)	12.6V (25.2V)	12.6V (25.2V)
Under Voltage Warning Reconnect Voltage	12.2V (24.4V)	12.2V (24.4V)	12.2V (24.4V)
Under Voltage Warning Voltage	12.0V (24.0V)	12.0V (24.0V)	12.0V (24.0V)
Low Voltage Disconnect Voltage	11.1V (22.2V)	11.1V (22.2V)	11.1V (22.2V)
Discharging Limit Voltage	10.8V (21.6V)	10.8V (21.6V)	10.8V (21.6V)
Equalize Duration	-------	2 hours	2 hours
Boost Duration	2 hours	2 hours	2 hours

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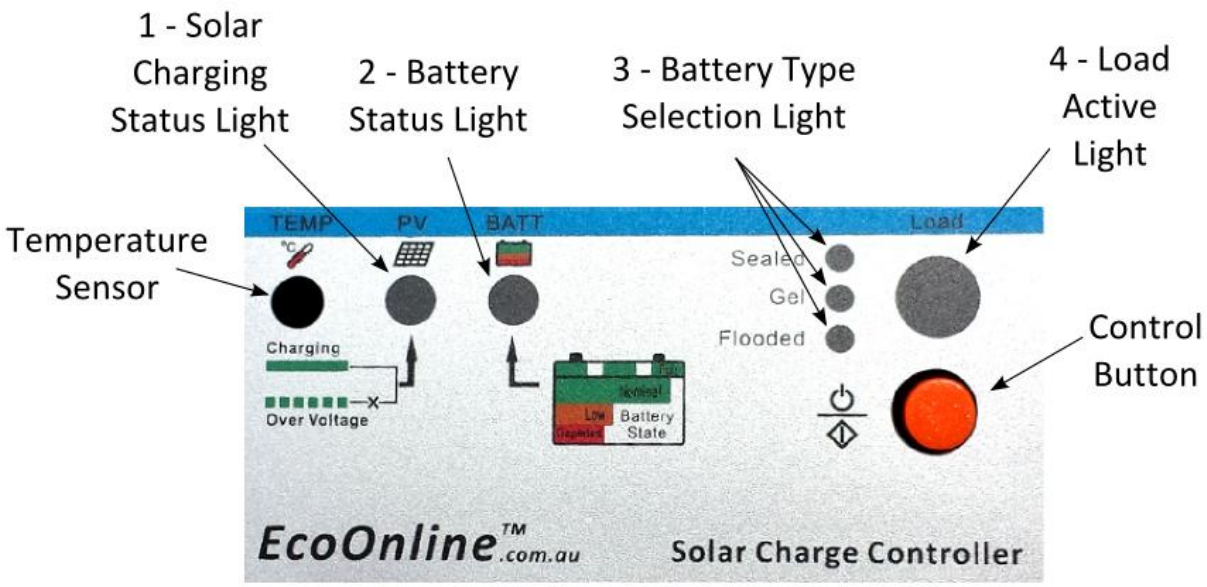
21 Operating Instructions



1 - Solar Charging Status Light	
Indicating Light	**Charging Status**
GREEN - ON Solid	Charging normal
GREEN - Fast flashing	Battery over voltage

2 - Battery Status Light	
Indicating Light	**Voltage Status**
GREEN - ON Solid	Battery Normal
GREEN - Slow flashing	Battery Full
ORANGE - ON Solid	Under voltage
RED - ON Solid	Depleted

3 - Battery Type Selection Lights	
Indicating Light(s)	**System Status**
RED Sealed, Gel OR Flooded light ON Solid	Indicates the charging profile selected
RED Sealed, Gel, Flooded lights flashing simultaneously	indicates the controller is overheated

To select the battery type **SEALED, GEL or FLOODED** (and hence appropriate charging profile):

- Hold down **Control Button** for 8 second until **Battery Type Selection** light starts flashing
- Press **Control Button** again to toggle through battery type selection
- Hold down **Control Button** again for 8 second to save selection until the appropriate **Battery Type Selection** light remains ON solid.

4 - Load Active Light	
Indicating	**Charging Status**
RED light OFF Solid	Load OFF (Not Active)
RED light ON Solid	Load ON or Active
RED light Flashing	Overload or Short

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22 System Maintenance

WARNING

Important: before carrying out any system maintenance you MUST check for any manual updates and download the latest installation manual from www.EcoOnline.com.au/downloads

The following inspections and maintenance tasks are recommended at least two times per year for best controller performance.

- Check that the controller is securely mounted in a clean and dry environment.
- Check that the air flow and ventilation around the controller is not blocked. Clear all dirt or fragments on the heat sink.
- Check fixings holding wiring in place.
- Check all wires to make sure insulation is not damaged from, UV exposure, frictional wear, moisture/corrosion, fatigue, insects or rats etc. Maintain or replace the wires if necessary.
- Make sure all terminal connections are tight. Inspect regulator connections for loose, corroded, broken, wires or signs of high temperatures such as discoloured or burnt areas.
- Confirm that all the system components are ground connected tightly and correctly if the system is grounded.
- Check that any fuses and fuse holders are not corroded and/or lose and/or warm or hot during operation. Replace as needed.

WARNING

Fatigued, weathered, loose and/or corroded wiring or electrical connections poses a fire risk even at low voltage. The systems wiring should be checked periodically for any wear, cracking resulting from UV damage of insulation on wiring and corrosion of any solder or controller connections. Any affected parts should be replaced at the first sign of damage.

23 Trouble Shooting Guide

Firstly, connect battery to regulators battery terminals (Note: battery MUST be at least 6V)
Does the regulator battery light turn ON? (Note: battery light is typically very faint)

✓ **Battery regulator light turns ON**
Next, connect solar panel to regulator solar ports
Measure charging current using multi-meter

✗ **Solar regulator light stays OFF**
Recheck connection, else, return regulator to EcoOnline for a Warranty Claim

✗ **Solar regulator light ON solid - NO current**
Return regulator to EcoOnline for a Warranty Claim

✗ **Battery regulator light stays OFF**
Measure voltage across the regulators battery connection screws

✓ **0 Volts Measured**
Re-check battery connections & fuse as 0V volts signifies improper connection and/or completely dead battery

✗ **Battery voltage measured but still no regulator lights**
Return regulator to EcoOnline for a Warranty Claim

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